Space Weather Technical Forecast

Issued on Tuesday, 21 June 2022 at 01:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Active electron fluence. Daily Chance of an isolated M-class flare.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with occasional C-class flares observed over the past 24 hours. The largest one was a C5.7 at 20/0618 UTC originating from AR3038. This region is now considered the largest and most complex one on the visible disc, having grown into a Dsi/Beta-gamma. Some C-class flares have also been observed originating from AR3030 (Dai/Beta-Gamma) near the northwest limb but this region has changed little over the past 24 hours.and is now approaching the western limb, soon expected to rotate away. All other regions are small or relatively simple and stable.

A CME was observed leaving the sun around 20/1745 UTC. The results of its analysis are not yet fully known but it's unlikely to be Earth-directed. No other CMEs were observed on available imagery. A large filament can also be seen hanging off the northwestern quadrant. It is currently stable but has showed signs of movement in recent days.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, was around 550 km/s and slowly declining initially when, around 20/1300 UTC, it suddenly rose to 600-620 km/s before coming back to 520-530 km/s after 20/1810 UTC. Its density was largely average but then rose to around 30 ppcc soon after 20/1300 UTC and only for a couple of hours, indicating a co-rotating Interaction Region (CIR). The IMF was generally weak (<8 nT) with small deviations in the north-south component, albeit with a prolonged period of negative Bz between 20/1300-1700 UTC. The phi angle was largely negative (towards the Sun), but became positive (away from the Sun) between from 20/1300-1800 UTC. These solar wind parameters seem to indicate a brief encounter with the fast speed stream originating from a negative coronal hole, resulting in a geomagnetic activity becoming temporarily Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured by GOES16 remained at background levels through the period. Electron flux (greater than 2MeV) was generally at Moderate to High levels in the period, with a peak of 2970pfu observed at GOES16 at 20/1450 UTC. The corresponding 24-hour integrated electron fluence remained above the Active threshold (>1e8 integrated pfu) through much of the period, reaching a peak of 1.26e8 integrated pfu at 20/1500 UTC. 1.08e8 integrated pfu were observed at 21/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low, with a daily chance of an isolated M-class flare and slight chance of an X-flare.

Solar Wind / Geomagnetic Activity: No CMEs feature in the forecast. Solar winds should continue their initial decline and return to slow-ambient levels by Day 2. They are expected to become slightly elevated at the end of Day 4, under the influence of a coronal hole HSS (CH93/-

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). Geomagnetic activity should be mostly Quiet with perhaps the odd Unsettled interval through much of the period, but become Unsettled to Active with a slight chance of a G1/Minor storm at the end of Day 4 (24th).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at Background levels during the period, but with a daily Slight Chance of an S1 or greater event occurring, due to the presence of a relatively large and complex sunspot region transiting over the western disc. The high energy electron flux (greater than 2 MeV) is expected to fluctuate between Moderate to High levels initially but to become confined to background levels by Day 4. The associated 24-hour integrated fluence is expected to remain above the Active threshold on Days 1 and 2 (21st and 22nd) and perhaps Day 3 (23rd) but the chance is considered unlikely on Day 4 (24th).

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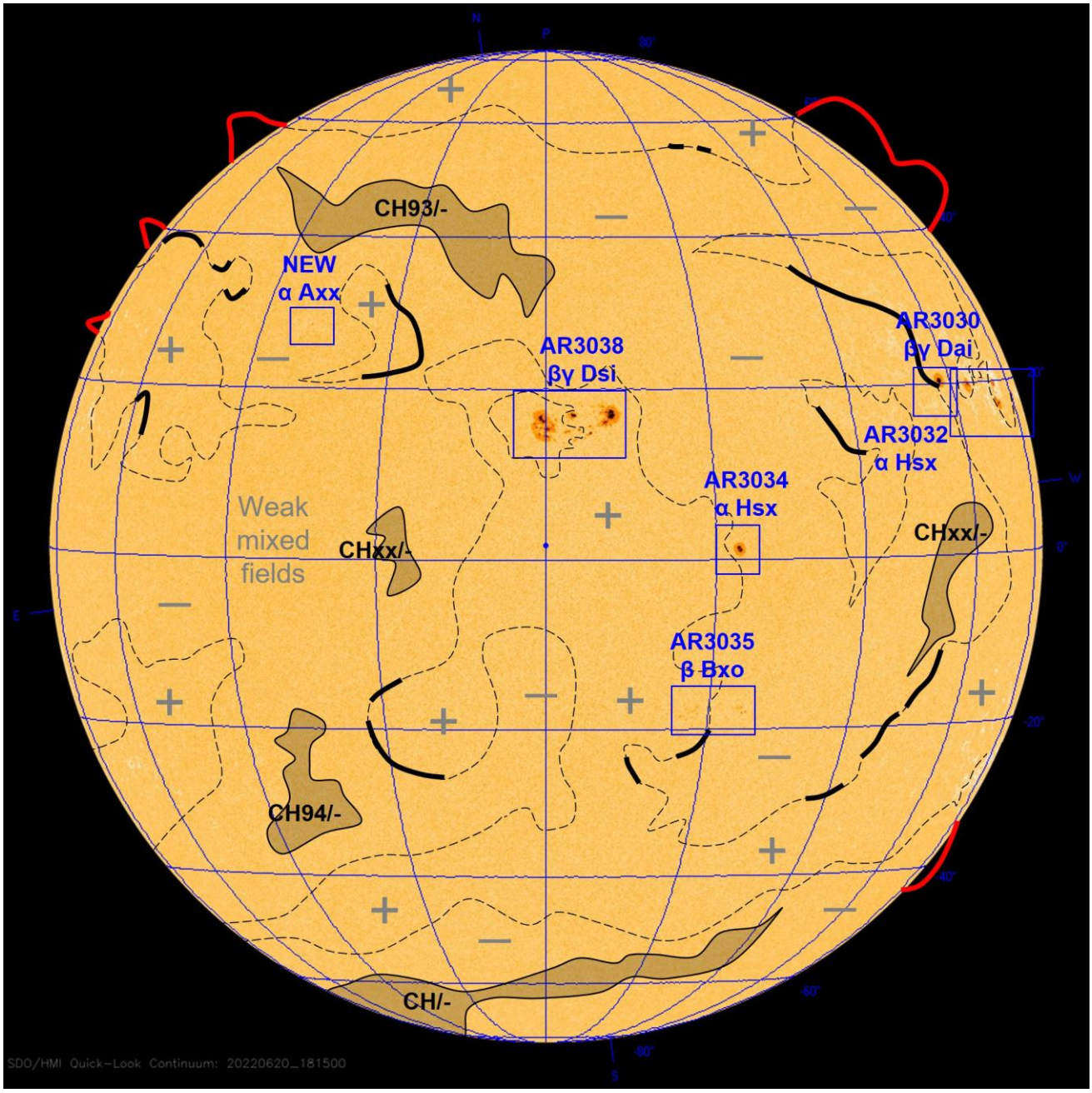
Figure 1. Solar Analysis Valid 20/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No CMEs feature in the forecast.

The Earth briefly encountered the fast speed stream of a negative coronal hole on the 20th. With no obvious signs of any significant coronal holes on the western hemisphere, solar winds should continue their initial decline and return to slow-ambient levels by Day 2, as suggested by the Met Office persistence model. The next coronal hole likely to affect Earth is CH93/+, currently approaching the central meridian in the north. Despite being a recurrent feature, it has considerably slowed down compared to the previous rotation and is not expected to be in a geoeffective location before the end of Day 4. The persistence model is not considered to provide good guidance in that respect.

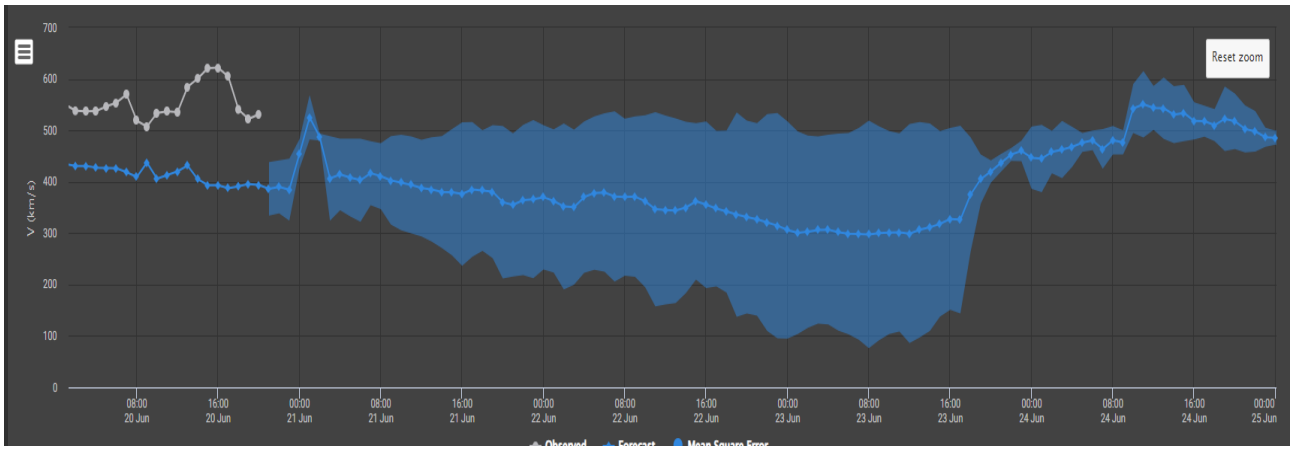
With this in mind, geomagnetic activity should be mostly Quiet with perhaps the odd Unsettled interval through much of the period, but become Unsettled to Active with a slight chance of a G1/Minor storm at the end of Day 4 (24th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

NIL

Figure 2: Solr Wind Persistence Model, showing an enhacement of the solar wind on 23rd, considered 24 hours too early



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Radio Blackouts - X-Ray Flares:
There are presently six sunspot regions on the visible disc, one of which is unnumbered. The largest and most complex region remains AR3038 (Dsi/Beta-Gamma), near the central meridian in the northern hemisphere. This region has continued to mature, becoming more elongated whilst developing slightly larger leading and trailing spots, along with a growth of their respective penumbra. AR3030 (Eao/Beta-Gamma) is also a region of note due to its size and complexity, but it has changed little over the past 6 hours. AR3031 has now rotated off the western limb and has been removed from the tables. All other regions on the disc remain magnetically simple and stable, the most recent addition of these being a unipolar region in the northeast quadrant.

Solar activity has been Low over the past 24 hours, with occasional C-class flares. Activity is likely to continue at Low levels, with a chance of an isolated M-class flare, and slight chance of an X-flare, most likely from AR3038 and perhaps AR3030.

The large filament on the northwest quadrant is showing signs of instability and will need to be monitored for any lift-off. Some bright flux regions are also visible on STEREO A EUVI195 imagery, around 110 degrees East, suggesting the presence of sunspots regions. These could potentially emerge from the far side over the following days, leading to a readjustment of the probabilities.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: Latest GOES X-Ray flux showing very low levels

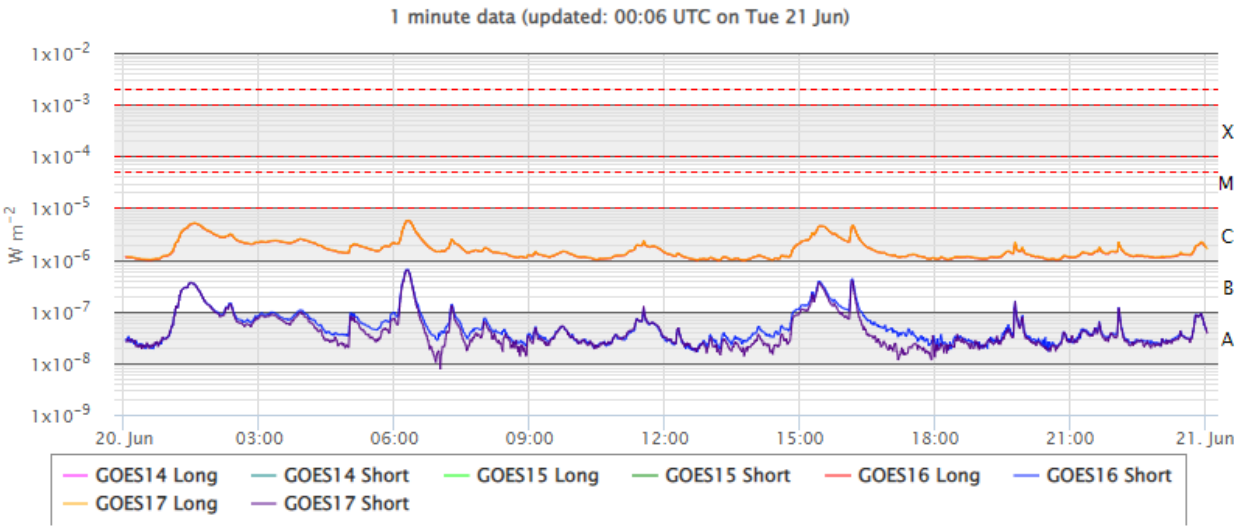

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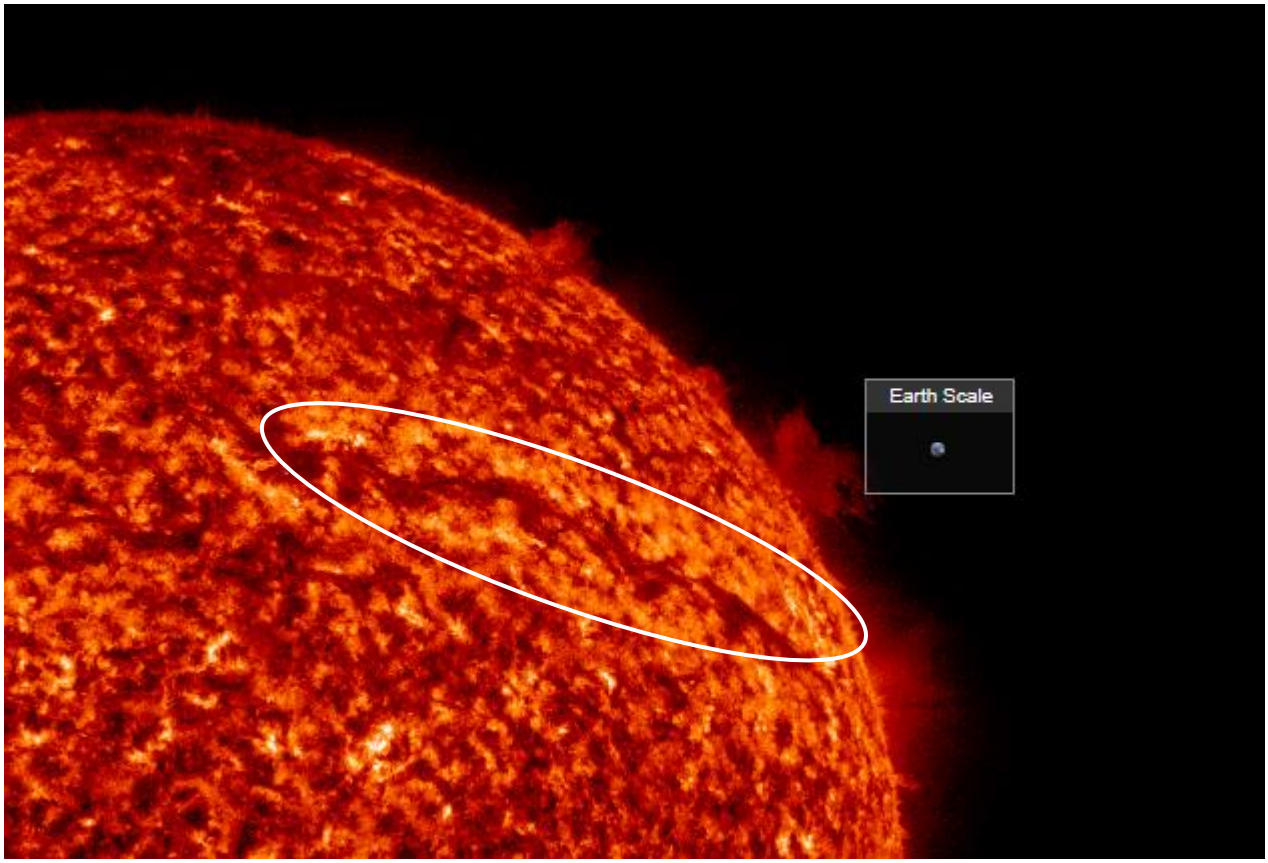
Figure 4: Helioviewer.org generated image showing a large and potentially unstable filament on the northwest quadrant



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels and is expected to remain at this level through the period. However, there is a slight chance of an S1 or greater event through the next four days as AR3038 rotate across the western disc. This region is relatively large, complex and keeps developing. As such, it carries a slightly elevated risk of solar radiation storm.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV), as observed by GOES16, rose to high levels, peaking at 2970ppcc at 20/1450 UTC, the radiations belts becoming charged following the HSS originating from CH90 and CH92. This pattern should continue on Days 1 and 2, the electron flux becoming high during the diurnal peak, though perhaps with an overall declining trend. As the solar wind returns to slow-ambient levels, the electron flux is expected to also reduce and become confined to background levels by Day 4.

The associated 24-hour integrated fluence is expected to remain above the Active threshold on Days 1 and 2 (21st and 22nd) and perhaps Day 3 (23rd) but the chance is considered unlikely on Day 4 (24th). This reflects a lack of confidence due to a volatile and often unpredictable electron flux. The REFM output is not considered to provide good guidance, the forecast considered too optimistic and the recurrence too pessimistic.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	80	60	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	10	10	5	1

Figure 5: GOES-16 >2MeV Electron Flux over the last 3 days

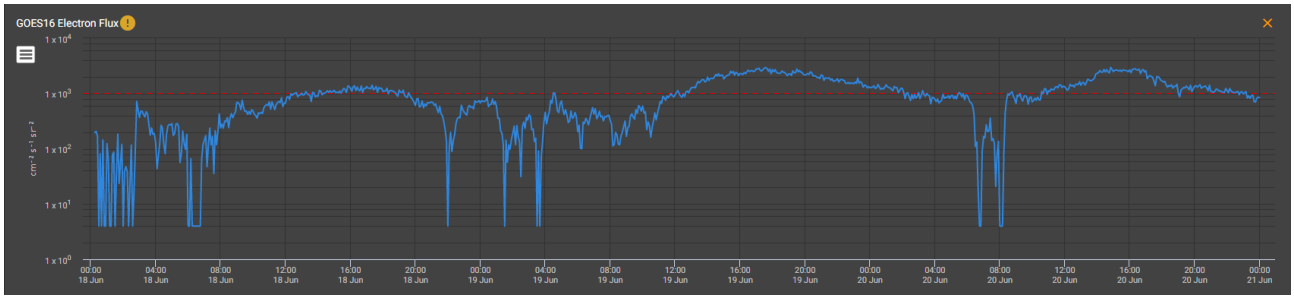

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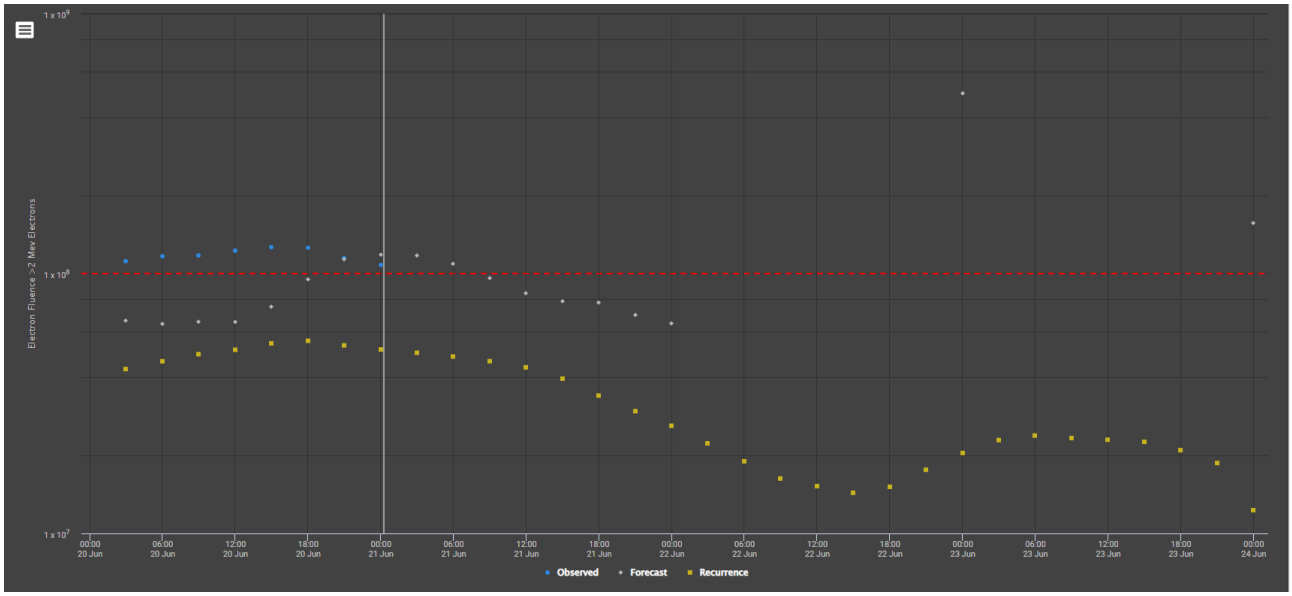
Figure 6: Latest Mnet Office REFM showing Forecast (white dots) and Reccurrence (Yellow dots)



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